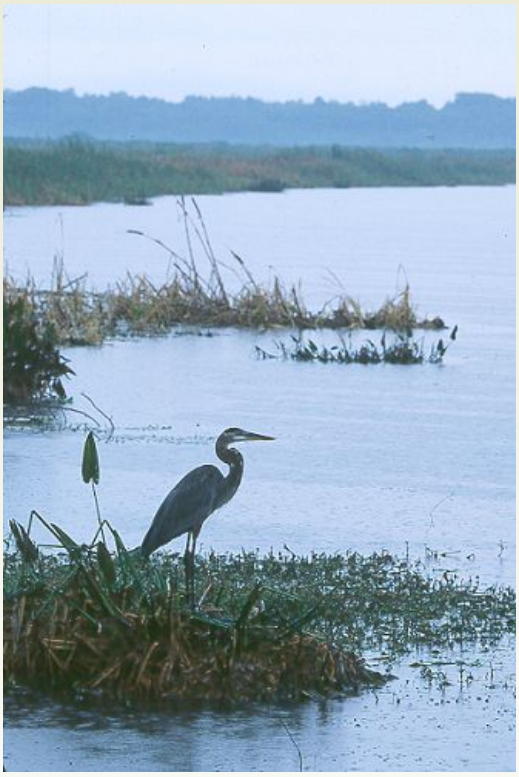
Harris Chain of Lakes Restoration Council

2005 Report

to the

Florida Legislature



Council Members

Hugh (Dave) Davis II, Chairman
Skip Goerner, Vice Chairman
Thomas A. Cook, MD, Secretary
W. Thomas Brooks, CPA
Charles C. Clark
Keith Farner
Robert Kaiser, P.E.
Donald Nicholson
Richard Powers, P.G.
Richard Royal

November 25, 2005

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All appendices are included on the CD that accompanies this report.

Acknowledgements

Wildlife photographs on cover courtesy of Dr. Peter May, Ph.D., Professor of Biology at Stetson University, DeLand, Florida taken during his studies of the Emeralda Marsh, located along the northern portions of the Harris Chain of Lakes.

Cover photograph of fishermen courtesy of Gerald Crawford of Bassmaster-The World Wide Authority on Bass Fishing, taken at the 2004 Florida Bassmaster Tour event on the Harris Chain of Lakes.

Harris Chain of Lakes Restoration Council
2005 Report to the Florida State Legislature

Executive Summary

The Harris Chain of Lakes Restoration Council (Council) was established during the 2001 Florida legislative session and, as required by Chapter 373.467 of the Florida Statutes, has prepared this *2005 Report to the Florida State Legislature*. **The purpose of the Council is to convene regular meetings in order to assess various restoration techniques and management practices to improve water quality and fisheries habitats within the Harris Chain of Lakes.** The 2005 Report discusses information gathered during technical presentations and updates provided by the various agencies and the Technical Advisory Group. The Council reviewed numerous restoration alternatives and adopted the following restoration priorities:

1.) Lake Griffin access canal dredging
2.) Wetland and aquatic vegetation enhancement
3.) Florida largemouth bass restocking
4.) Control of nuisance aquatic vegetation
5.) Cyanobacteria monitoring

During the period of November 2004 through October 2005 the Council convened 11 regular monthly meetings and attended one site visit to the Lake Apopka North Shore Restoration Area to view a variety of projects intended to reduce nutrient rich runoff to the Lake Apopka and the Harris Chain of Lakes. The Council was provided technical information regarding impacts of historical and existing management practices on water quality, fisheries habitat, and recreational use of water bodies in the Harris Chain of Lakes and associated watersheds in the Upper Ocklawaha River Basin. Technical presentations were made and information was provided by several state and local agencies including the St. Johns River Water Management District (SJRWMD), Florida Department of Environmental Protection (FDEP), Florida Fish and Wildlife Conservation Commission (FWCC), Lake County Water Authority (LCWA), University of Florida (UF), and the UF Institute of Food and Agricultural Sciences (IFAS). As required by the enacting legislation a Technical Advisory Group (TAG) was formed of representatives from these groups and served the Council through the year. Additional information was provided by private citizens, representatives of private industry, and other agencies.

Through the course of the 2005 reporting period the Council developed specific recommendations concerning the restoration initiatives and lake management practices as described below:

Enhanced Lake Level Fluctuation

This lake management issue addresses enhanced lake level fluctuation that will provide a wider range of fluctuations for the lakes, aide in restoring natural vegetation and fisheries habitat, and ultimately improve water quality. Water levels in the Harris Chain of Lakes have been largely controlled by weirs, dams and locks. Poor water quality and habitat within the Harris Chain of Lakes can be partially attributed to 40 years of these artificially controlled water levels in the lakes. The SJRWMD has an approved water level fluctuation schedule that provides for a wider range of fluctuations.

> The Council endorsed the modified lake level fluctuation schedule previously approved by the St. Johns River Water Management District and the positive effects that it would have on aquatic habitat and water quality.

Access Canal Dredging

This lake management issue addresses the availability of boating access during periods of lake level fluctuation, drawdown or drought. The LCWA received the required permits and began access canal dredging in Lake Griffin in July 2005. Completion of the access canal dredging project is required prior to implementing an enhanced lake level fluctuation schedule.

> The Council supports access canal dredging on Lake Griffin to improve navigability of the lake during periods of lowered water levels and was awarded $1 million of their 2004 - 2005 funding request from the Florida Legislature to assist the Lake County Water Authority with the costs of dredging. The Council had previously received $500,000 in Legislative funding (2003) for a cumulative total of $1.5 million to assist in access canal dredging.

Aquatic Plant Management and Weed Control

Another lake management issue discussed was the control of invasive species of aquatic plants including hydrilla, water hyacinths and water lettuce. At issue is the process of invasive species of aquatic plants "crowding out" more desirable and beneficial species of plants.

> The Council supports the invasive plant management efforts of the St. Johns River Water Management District, Florida Fish and Wildlife Conservation Commission, and the Lake County Mosquito and Aquatic Plant Management Section and was awarded $56,250 of their 2004 – 2005 funding request from the Florida Legislature to assist in these efforts.

Revegetation of Aquatic Habitat and Cypress Tree Plantings

This lake restoration measure involves better management and the revegetation of near-shore aquatic habitat to provide improved fisheries habitat and water quality. The SJRWMD, FWCC and LCWA are all actively involved in aquatic plant revegetation for improved water quality and sport fish habitat.

The Council supports near-shore aquatic revegetation as a means of water quality improvement and habitat restoration and was awarded $37,500 of their 2004 – 2005 funding request from the Florida Legislature to support revegetation of aquatic habitat efforts.

The Council had also previously received information on the benefits of improved wetland habitat through the planting of cypress trees. It was discussed that cypress trees play a key role in the uptake of nutrients in wetland systems and improve wildlife habitat. Areas that would benefit from this restoration effort include the Lake Apopka Marsh Flow-way, Emeralda Marsh and the Lake Apopka North Shore Restoration Area.

The Council supports cypress trees plantings and wetland restoration efforts of the St. Johns River Water Management District, Florida Fish and Wildlife Conservation Commission and Lake County Water Authority. In their 2004 – 2005 funding request to the Florida Legislature the Council was awarded $18,750 to assist in cypress tree planting and wetland restoration efforts.

Sport Fish Restocking

Another lake management tool reviewed by the Council was the practice of sport fish restocking, coupled with improved habitat management to provide both water quality benefits and recreational fisheries improvement. The FWCC made multiple presentations to the Council on their research, fish counts and breeding efforts.

The Council supports the sport fish restocking research and efforts being conducted by the Lake County Water Authority and University of Florida. In their 2004 – 2005 funding request to the Florida Legislature the Council was awarded $187,500 to assist in bass restocking efforts. The Council also passed Resolution No. 2005-2 in October 2005 to transfer these funds to the Lake County Water Authority for disbursement to the proper receiving agency.

Potentially Toxic Algae

Another issue discussed was the potential health impacts associated with infections that may be attributed to the release of biotoxins and neurotoxins from blue-green algae identified in lakes and rivers throughout Florida. In July 2003 the Council was presented research by a medical expert in the diagnosis and treatment of people who may have become infected by biotoxins produced by algae. In July 2004 the Council was presented with information provided by a representative of the Florida Department of Health regarding the occurrence and reporting of algal bloom toxins and the infections caused by them. In December 2004 the Council was presented with research by a professor of Aquatic Botany and Marine Sciences at North Carolina State University. This presentation focused on the consideration of strain differences among populations within the same species of harmful algae.

The Council recognizes the potential human health concerns associated with algal blooms and initiated a program to educate local health professionals on this issue. During the October 2005 Council meeting a motion was passed to include $250,000 in their 2005 – 2006 Legislative Funding Request for cyanobacteria monitoring, to be used in cooperation with the Florida Department of Health.

Rough Fish Harvest

This lake management technique addresses the potential reduction of phosphorus and improvement of water quality through the removal of rough fish, primarily gizzard shad, from the lakes. Estimates of the number of shad harvested and the amount of phosphorus reduction that may be associated with their removal were presented to the Council by the SJRWMD. However, this effort is an experimental technique and the SJRWMD is in the process of conducting a study to more accurately determine the effectiveness of the harvests to remove phosphorus.

The Council continued to support this experimental lake management technique as a possible method for improving water quality and is awaiting the results of an independent evaluation of the information presented by St. Johns River Water Management District before deciding whether to endorse the rough fish harvest as a means of water quality improvement.

Lake Apopka Marsh Flow-way System

In November 2003 the SJRWMD began operation of the Lake Apopka Marsh Flow-way located near the northwest portion of Lake Apopka. The flow-way was constructed on former agricultural land that had been purchased by the SJRWMD and is located at the southern end of the Apopka-Beauclair Canal. Water from Lake Apopka enters the flow-way via the canal and then passes through a series of treatment cells where natural biological processes, along with the settling of nutrients like phosphorus and suspended solids takes place. The treated water is then pumped back into the canal where the majority of the water flows back into Lake Apopka and a portion of it enters the Harris Chain of Lakes.

The Council continued to review the effectiveness of the flow-way at removing suspended solids, nitrogen and phosphorus and is closely monitoring the dissolved oxygen concentration of the water discharged, which is below desirable levels.

Total Maximum Daily Loads and Pollutant Load Reduction Goals

The FDEP and SJRWMD provided information to the Council regarding the development of Total Maximum Daily Loads (TMDLs) and Pollutant Load Reduction Goals (PLRGs) guidelines and implementation. The SJRWMD initially developed PLRGs that are defined as an estimated numeric reduction in pollutant load that would be required to preserve or restore water quality consistent with applicable state water quality standards. Upon review of the PLRGs the FDEP developed TMDLs for the lakes within the Harris Chain of Lakes. TMDLs are the

maximum load of nutrients and pollutants that can enter a water body in order to bring impaired waters back into compliance with state water quality standards and to meet the program goals. The FDEP also developed target concentrations for the individual nutrients and pollutants to assist in meeting the TMDLs.

> The Council supports the efforts of the Florida Department of Environmental Protection and the water quality improvements the Total Maximum Daily Load program will bring. The Council will continue to monitor the implementation of Pollutant Load Reduction Goal and the Total Maximum Daily Load Programs.

Industrial, Wastewater, and Stormwater Impacts

The Council also reviewed industrial, wastewater and stormwater management practices designed to minimize discharges that could impact water quality in the lakes. Regular updates on the progress of the City of Leesburg Department of Environmental of Services to upgrade their existing sanitary sewer and wastewater treatment facilities were provided to the Council.

> The Council supports the continued efforts of the City of Leesburg Department of Environmental Services in their reorganization and upgrading of facilities.

The Council was also provided technical presentations on the following water quality improvement projects:

Lake Beauclair Nutrient Reduction Facility

The Lake Beauclair Nutrient Reduction Facility is proposed to reduce phosphorus in the water from the Apopka-Beauclair Canal. Treatment would occur prior the water to being discharged into Lake Beauclair in an effort to meet State water quality standards and the PLRG for the lake. The system will divert water from the canal where it will receive flocculation treatment with aluminum sulfate or alum. This treatment will initiate the settling of phosphorus, along with other nutrients and sediments. Once the flocculated solids settle, the water will be released to Lake Beauclair. This project is currently in the design stage and no construction has commenced.

> The Council will continue to review the information provided by the Lake County Water Authority for the design and implementation of the Lake Beauclair Nutrient Reduction Facility.

Lake Apopka North Shore Restoration Area

The north shore of Lake Apopka has been historically used for farming operations. For nearly 50 years these agricultural operations known as muck farms, discharged fertilizers (nutrients), herbicides and pesticides into Lake Apopka, which caused severe environmental degradation to the lake. The SJRWMD is involved in several

projects to reduce the level of nutrients in the water discharged from this area, increase the water storage capacity, and improve wetland / marsh wildlife habitat.

The Council will continue to review projects and information provided by the St. Johns River Water Management District for the North Shore Restoration Area.

Emeralda Marsh Projects

The Emeralda Marsh is located between Lake Yale and Lake Griffin. Beginning in the 1950s a system of levees and canals were built to drain this 6,500 acre sawgrass marsh in order to establish farms in the nutrient-rich muck. As with the area north of Lake Apopka, the muck farming activities discharged excess nutrients, primarily phosphorus into Lake Griffin. The SJRWMD is involved in several projects to reduce the level of nutrients in the water discharged from this area, increase the water storage capacity, and improve wetland / marsh wildlife habitat.

The Council will continue to review the evolution of wetland restoration efforts of the St. Johns River Water Management District as a method to better manage water levels and water quality in the Emeralda Marsh and Harris Chain of Lakes.

Funding

The issues of cost and available funding for projects were discussed throughout the year. The Council was provided information on the costs of implementing the various water quality improvement technologies and lake management practices, along with the potential benefits to be derived from their implementation. The Council voted and approved the following funding requests:

<u>Individual Funding Request</u>

- The Council passed a motion to support the appropriation of $2,000,000 in State funds to assist the Lake County Water Authority in the completion of the Lake Griffin Access Canal Dredging Project.

<u>Combined Funding Initiative Request</u>

- The Council passed a motion to support the appropriation of $300,000 in State funds for the purpose of Florida largemouth bass restocking to improve the economic vitality of the Harris Chain of Lakes.

- The Council passed a motion to support the appropriation of $300,000 in State funds for the purpose of wetland and aquatic habitat restoration.

- The Council passed a motion to support the appropriation of $150,000 in State funds to the Lake County Mosquito and Aquatic Plant Management

Section to assist in funding their efforts to control invasive species of aquatic plants.

- The Council passed a motion to support of the appropriation of $250,000 in State funds to support cyanobacteria monitoring in cooperation with the Florida Department of Health in the Harris Chain of Lakes.

1.0 Establishment of the Harris Chain of Lakes Restoration Council

The environmental impacts to and the economic importance of the Harris Chain of Lakes (HCOL) led to the creation of the Harris Chain of Lakes Restoration Council (Council) during the 2001 Florida Legislative Session. A copy of Chapter 373.467, Florida Statutes (F.S.), the enacting legislation, is provided as Appendix 1 of this report.

Over the past decade, declining water quality, habitat, and fisheries have resulted in substantial economic losses to this region of central Florida. The purpose of the Council is to gather and review information provided by a variety of state and local government representatives, and by academic and industry experts, on the most effective environmental restoration technologies available to improve the water quality, habitat and fish populations of the Harris Chain of Lakes. Based on the information provided and the availability of funding, the Council then moves forward to apply the recommended environmental restorative measures.

The Harris Chain of Lakes (Figure 1) are the headwaters of the Ocklawaha River and includes lakes and interconnecting waters from Lake Apopka (30,808 acres) at the south end of the chain to Lake Griffin (9,412 acres) at the north end. The lakes are located primarily in Lake and Orange counties and also include; Lake Beauclair (1,080 acres), Lake Dora (4,385 acres), Little Lake Harris (3,359 acres), Lake Harris (15,087 acres), Lake Eustis (7,757 acres), and Lake Yale (4,020 acres). An overview of the Harris Chain of Lakes in provided as Appendix 2.

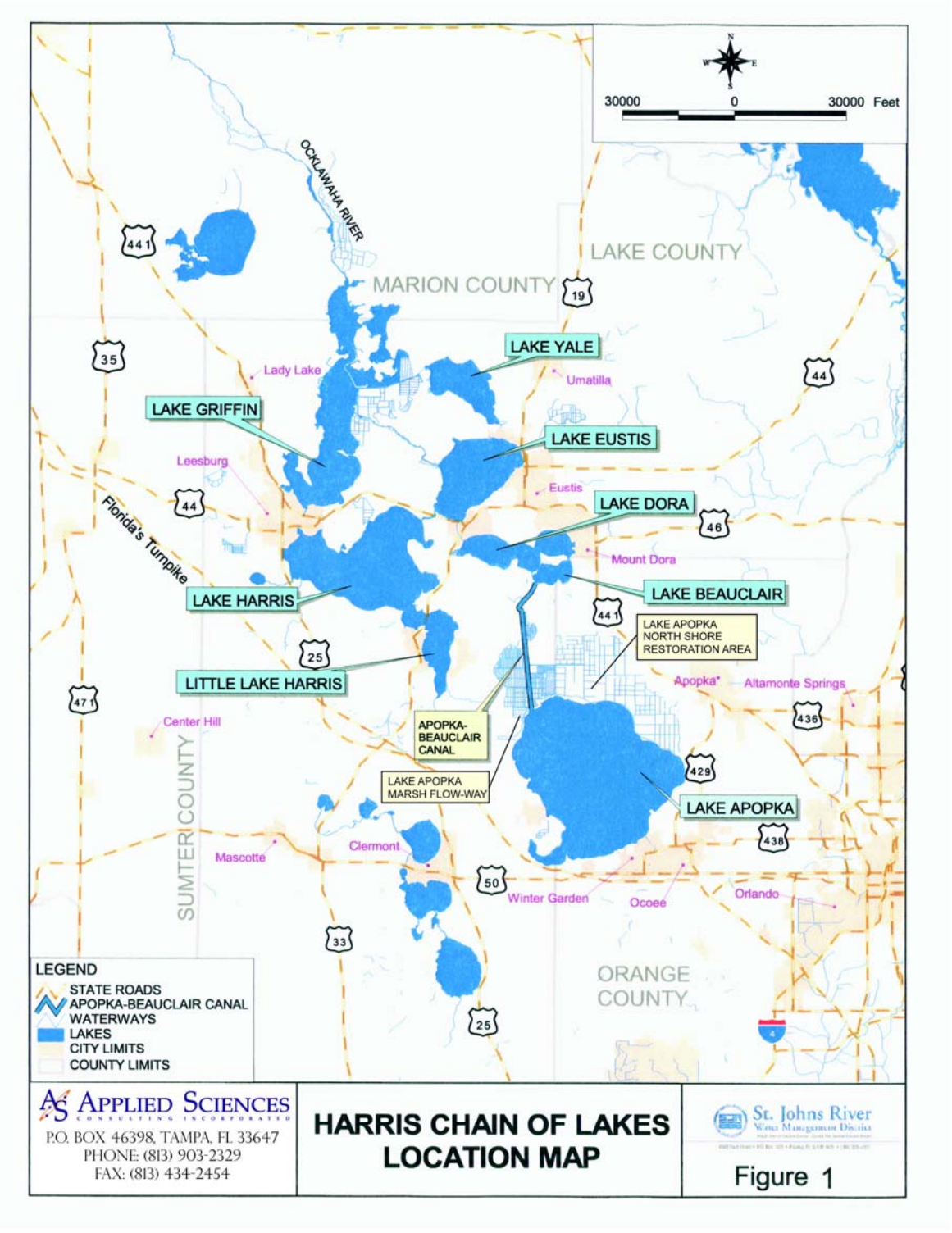
The Harris Chain of Lakes provides significant recreational opportunities and associated economic value, along with abundant natural resources for Florida's fish and wildlife. The Harris Chain of Lakes is federally designated as navigable water under Chapter 33, Code of Federal Regulations (CFR), Part 329.11 and the Lake Griffin State Park is designated as Outstanding Florida Waters (OFW) by Section 62-302.700, Florida Administrative Code (F.A.C.).

As required by the Florida State Legislature and the enacting legislation, the Council has reported to the President of the Senate and Speaker of the House of Representatives before November 25th of each year on the progress of the Harris Chain of Lakes restoration program and any recommendations for the next fiscal year. The Council has submitted the following annual reports:

- *Harris Chain of Lakes Restoration Council Report to the Legislature, November 25, 2001*;
- *Harris Chain of Lakes Restoration Council 2002 Report to the Florida Legislature*;
- *Harris Chain of Lakes Restoration Council 2003 Report to the Florida Legislature,* and;

- *Harris Chain of Lakes Restoration Council 2004 Report to the Florida Legislature.*

Figure 1.
Harris Chain of Lakes located in the Upper Ocklawaha River Basin.



1.1 Representation

Membership on the Council was initially appointed by the Lake County Delegation which is chaired by Senator Anna Cowin (R, District 11). The Council consists of nine voting members representing a broad spectrum of expertise and interests as outlined in Chapter 373.467, F.S. The Council elected the positions of Chairman, Vice Chairman, and Secretary, who shall serve for a period of two years and not serve consecutive terms. Below is the list of 2005 Council members and officers as elected in December 2003.

Member	Position	Representing
Hugh (Dave) Davis, II	Chairman	Legal Profession (Attorney)
Skip Goerner	Vice Chairman	Sport Fishing Industry
Thomas A. Cook, M.D.	Secretary	Medical Profession (Physician)
W. Thomas (Tom) Brooks, CPA		Member at Large
Charles C. Clark (Resigned 6/12/05)		Biological Science
Keith Farner		Member at Large
Robert Kaiser, P.E.		Engineering
Donald Nicholson		Waterfront Property Owners
Richard Powers, P.G.		Environmental Engineering
Richard Royal		Biological Science

In June 2005, Charles C. Clark tendered a resignation with Senator Carey Baker and the Florida Legislature. Mr. Clark did not vote on the on the approval of this annual report.

Richard Royal was approved as a member of the Council in October 2005.

Prior to final approval of this annual report, the Council received and accepted the resignations of councilmen Dr. Thomas A. Cook and W. Thomas Brooks for medical reasons. These former councilmen did not participate in the vote to approve the final report.

Additionally, Patrick F. Hunter, an Environmental Scientist with a private consulting firm has performed the duties of Recording Secretary beginning March 2003 through October 2005. Mr. Hunter is not an appointed or elected member of the Council.

The enacting legislation also provided for the creation of a Technical Advisory Group (TAG) to serve the Council for the purpose of providing scientific information along with both technical data and guidance in their review of various technologies and issues that come before it. As of October 31, 2005 the TAG was comprised of the following individuals and their representing agencies or organizations:

Larry Battoe, Ph. D.	St. Johns River Water Management District
Barbara Bess	Florida Department of Environmental Protection
Bill Johnson	Florida Fish and Wildlife Conservation Commission
Michael J. Perry	Lake County Water Authority
Stephen Tonjes	Florida Department of Transportation
Daniel Canfield, Ph.D.	University of Florida - Institute of Food and Agricultural Sciences
Peter Milam	U. S. Army Corps of Engineers

1.2 Duties and Responsibilities

Through Chapter 373.467, F.S., the Council is charged with the following duties and responsibilities:

(a) Review audits and all data specifically related to lake restoration techniques and sport fish population recovery strategies, including data and strategies for shoreline restoration, sediment control and removal, exotic species management, floating tussock management or removal, navigation, water quality, and fish and wildlife habitat improvement, particularly as they may apply to the Harris Chain of Lakes.

(b) Evaluate whether additional studies are needed.

(c) Explore all possible sources of funding to conduct the restoration activities.

(d) Report to the President of the Senate and Speaker of the House of Representatives before November 25 of each year on the progress of the Harris Chain of Lakes restoration program and any recommendations for the next fiscal year.

2.0 Progress Report of the Harris Chain of Lakes Restoration Council 2005

Since the 2004 Report to the Florida Legislature, the Council and TAG have continued to review various technologies and data relating to water quality and habitat restoration in the Harris Chain of Lakes. The Council developed recommendations, pursuant to Section 373.467, F.S., based on the information gathered.

2.1 Summary of 2005 Meetings and Presentations

The Council convened nine regular monthly meetings and attended one site visit to the Lake Apopka North Shore Restoration Area during the period of November 2004 through October 2005. The Council was presented scientific information and data which included water quality, aquatic habitat, fisheries status, and restorative measures as they relate to the Harris Chain of Lakes. The analytical data and scientific information reviewed addressed water quality and toxicology; littoral vegetation and fish habitat; fish restocking to provide water quality and economic benefits to the region; fish harvests as they relate to water quality; lake access canal dredging; along with other lake management issues. The Council also reviewed previous, on-going and future projects in the Upper Ocklawaha River Basin that relate to water quality and aquatic habitat. The information received was reviewed and discussed by the Council in detail, and was used as the basis for developing recommendations of restorative measures and management practices for the Harris Chain of Lakes.

During the monthly meetings the Council was provided technical information regarding impacts of historic and existing management practices on the Harris Chain of Lakes and the Upper Ocklawaha River Basin. Technical presentations were made and information was provided by several state and local agencies including the St. Johns River Water Management District (SJRWMD), Florida Department of Environmental Protection (FDEP), Florida Department of Health (FDOH), Florida Fish and Wildlife Conservation Commission (FWCC), Lake County Water Authority (LCWA), University of Florida (UF), the UF Institute of Food and Agricultural Sciences (IFAS), and the TAG to the Council. Additionally, the Council was provided a technical presentation by Dr. JoAnn Burkholder, Associate Professor of Aquatic Botany and Marine Sciences at North Carolina State University. Below is a list of the presentations made to the Council:

12/3/04 Dr. JoAnn Burkholder, an Associate Professor of Aquatic Botany and Marine Sciences at North Carolina State University gave a presentation on potentially toxic cyanobacteria (blue-green algae) that may be present in algal blooms found in the Harris Chain of Lakes.

3/4/05 Dr. Mike Allen, a Scientist with the Fisheries and Aquatic Sciences Department at the UF gave a presentation on gizzard shad and hydrilla management in area lakes.

Councilman Charles Clark gave a presentation of the phosphorus data he has collected from the SJRWMD on Lake Beauclair. He prepared a collection of graphs that compared total phosphorus in the various lakes to flow rates, rainfall and other factors in several of the lakes in the Harris Chain of Lakes.

Dave Walker, a Senior Project Manager with the SJRWMD gave a presentation on the Emeralda Marsh and Lake Griffin Flow-way projects.

4/1/05 Lance Lombard, a Water Resources Project Manager with the LCWA gave a presentation on the Lake Beauclair Nutrient Reduction Facility proposed to be constructed near the north end of the Apopka-Beauclair Canal.

Barbara Bess, Watershed Management Coordinator with the FDEP gave a presentation on the Total Maximum Daily Load Program including the status of the program and rule development.

5/6/05 Sanford Minkoff, the County Attorney for Lake County gave a presentation on the application of the Florida Sunshine Laws and public records as they relate to the Council.

6/3/05 Rick Stout of the FWCC and Manager of the Richloam State Fish Hatchery gave a presentation of the status of renovations and operations of the Richloam State Fish Hatchery.

Eric Reich, Ph.D., Environmental Manager, Bureau of Environmental Toxicology of the Florida Department of Health provided an update on efforts they are involved with regarding public education, regulation and monitoring of cyanobacteria.

7/8/05 Florida State Senator Carey Baker provided an overview of the environmental projects and appropriations supported by the Legislative during the 2005 Legislative Session.

8/5/05 Dr. Mike Coveney, a Technical Program Manager with the SJRWMD and Dr. Gian Basili, a Senior Project Manager with the SJRWMD gave presentations on projects involving Lake Apopka and Lake Beauclair.

10/7/05 Ed Taylor, President of River City Tournaments gave a presentation on four proposed bass fishing tournaments for 2006 on the Harris Chain of Lakes.

Throughout the year the TAG provided technical information and presentations to the Council in support of water quality and restorative issues being reviewed for the Harris Chain of Lakes. Excerpts of the meeting minutes including the presentations for the period of November 2004 through October 2005 are provided in Appendix 3

of this report. Summaries of the lake management issues discussed and the actions taken during the 2004 – 2005 period are presented in the following sections.

2.2 Management Issues Reviewed and Recommended Actions

The Council has reviewed numerous management issues and restorative techniques since their inception in September 2001. After thorough review and discussion of the data provided during technical presentations and agency updates, the Council made recommendations regarding these issues as provided below.

2.2.1 Enhanced Lake Level Fluctuation

Issue: Enhanced lake level fluctuation to improve aquatic vegetation management and flood control.

Actions: The Council endorsed the modified lake level fluctuation schedule previously approved by the St. Johns River Water Management District.

Poor water quality and habitat within the Harris Chain of Lakes can be partially attributed to 40 years of artificially controlled water levels in the lakes. The SJRWMD has an approved water level fluctuation schedule that will provide a wider range of fluctuations in the lakes to aid in the restoration of natural vegetation and habitat. This lake management practice will primarily provide improved near shore aquatic vegetation management and improved sport fish habitat.

In May 2002 the SJRWMD Governing Board approved an interim water level fluctuation schedule for Lake Griffin, and the permits to conduct "massive" drawdowns have been approved by the FDEP and the Army Corps of Engineers (ACoE). Enhanced fluctuation levels approved for Lake Griffin range from 54 feet above the National Geodetic Vertical Datum (NGVD) to 59.5 feet NGVD, as established by the ACoE.

As an overall restoration measure to be considered for the Harris Chain of Lakes, the Council determined that modified lake level fluctuations and drawdowns would provide substantial improvements to shoreline aquatic and fisheries habitat in the short term. Water quality improvements may be realized over the long term as a result of improved vegetation management and other lake restoration efforts. Prior to implementing the modified fluctuation schedule the Lake Griffin Access Canal Dredging project will be complete and the following environmental conditions warrant the fluctuation:

- Ecological conditions that indicate the need for enhanced fluctuations.
- Satisfactory climatological conditions expected for time period (for example, enhanced fluctuations would not be attempted during an El Nino' winter).
- Previous or current years should not have experienced drought conditions.
- Satisfactory conditions to store some additional water in upstream lakes.

The Council endorsed the modified lake level fluctuation schedule and the positive effects that it would have on aquatic habitat and water quality.

2.2.2 Access Canal Dredging

Issue: **Improving lake access at lowered water levels.**

Actions: **The Council supports access canal dredging as a beneficial and necessary lake management practice, and was awarded $1 million in State appropriations from the Florida Legislature in 2005 to assist in funding the dredging project. The Council had previously received $500,000 in Legislative funding (2003) for a cumulative total of $1.5 million to assist in access canal dredging.**

The issue of access canal dredging is a major concern for those who utilize Lake Griffin recreationally. During periods of lake level fluctuation, drawdown or drought, boating access is limited because of the inability to navigate the shallow canals due to accumulated sediments. Dredging the canals will increase the depth of the canals in Lake Griffin and provide improved access during periods of lowered water levels. Improved access to those who utilize the lake has been a concern of the Council and they support the access canal dredging efforts.

Over the previous three years the Council has been provided information on the benefits and implications of access canal dredging, along with the progress of the dredging project. It was determined that access canal dredging was a necessary part of the enhanced lake level fluctuation schedule and the overall plan of restoration. This project coupled with the Enhanced Lake Level Fluctuation and Management Program is considered a Priority 1 – Upper Ocklawaha River Basin (UORB) and Lake Apopka Funding Initiative being prepared by the SJRWMD.

In July 2004 the Council was notified that the SJRWMD had received permit approval by the ACoE to utilize the Eustis muck farm as a disposal site for the dredge material from the access canals. Additionally, in July 2004 it was announced that the LCWA had received ACoE permit approval to begin the access canal dredging. A contract was signed with a dredging contractor in January 2005 and dredging began in July 2005.

Mike Perry, Executive Director of the LCWA provided regular updates on the dredging project to the Council during the monthly meetings. In October 2005 he informed the Council that dredging had been completed on Canals 9A, 9B and 9C, and dredging of Canal 10 was underway. Dredging of the Lake Griffin access canals is anticipated to be completed by January 2007.

The Council fully supports access canal dredging on Lake Griffin to improve navigability of the lake during periods of lowered water levels and was awarded $1 million of their funding request from the Florida Legislature to assist the LCWA

with the costs of dredging. The following resolution to transfer those funds to the LCWA was approved by the Council in the September 9, 2005 meeting: Resolution No. 2005-1; A RESOLUTION OF THE HARRIS CHAIN OF LAKES RESTORATION COUNCIL REQUESTING THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT TO TRANSFER $1,000,000 IN 2005 STATE APPROPRIATIONS TO THE LAKE COUNTY WATER AUTHORITY FOR THE PURPOSE OF CANAL ACCESS DREDGING EFFORTS ON LAKE GRIFFIN. A copy of the resolution is provided in Appendix 4.

2.2.3 Aquatic Plant Management and Weed Control

Issues: **Invasive aquatic vegetation has the potential to overpopulate the lakes in the chain and crowd out more desirable species of aquatic plants.**

Actions: **The Council supports the invasive plant management efforts of the St. Johns River Water Management District, Florida Fish and Wildlife Conservation Commission, and the Lake County Mosquito and Aquatic Plant Management Section. The Council was awarded $56,250 in State appropriations from the Florida Legislature in 2005 to assist the Lake County Mosquito and Aquatic Plant Management Section in their invasive plant management efforts.**

Another lake management issue discussed throughout the year was the control of exotic / invasive species of aquatic plants including hydrilla, water hyacinths and water lettuce. An exotic species of plant is one that is non-native to the region it is found in, having been introduced by various means from outside the region. An invasive species of plant is one that spreads rapidly, utilizing the nutrients and resources required for growth by native species. At issue is the potential for invasive species of aquatic plants to "crowd out" more desirable and beneficial species of plants, such as eel grass, knot grass and bulrush. The most pervasive of these aquatic plants is hydrilla.

In March 2005 the Council was presented with information on hydrilla management by Dr. Mike Allen of the UF Fisheries and Aquatic Sciences Department. Dr. Allen had attended a meeting of aquatic plant management professionals in December 2004 during which the most recent hydrilla management strategies and techniques were discussed. Presentations were made at the meeting by representatives of the U.S. Fish and Wildlife Service (FWS), ACoE, FDEP, FWCC, the State water management districts, county governmental agencies and the Bass Anglers Sportsman Society (B.A.S.S.).

An outline of the presentation given by Dr. Allen to the Council is provided below and the complete presentation is provided in Appendix 5.

Hydrilla

- An exotic, non-native species
- Provides quality fish and wildlife habitat
- Can dominate the shallow, Florida lakes

Methods of Control

Chemical treatment with Sonar (Fluridone) which attacks a specific enzyme in hydrilla

- This product has been used for 15 years
- Large acreages of control
- Low costs / economical
- Selective – only effective on hydrilla and minimizes damage to native plants
- More resistant strains are evolving which require higher doses of Fluridone that can be harmful to native plants like bulrush, knot grass and eel grass

Grass Carp

- Drawback – the grass carp will feed on native species of vegetation when the hydrilla is gone

Other herbicides

- Greater expense and not economical on large lakes

Mechanical methods

- Effective in small areas like boat ramps, fish camps, canals, etc.
- Not feasible for large lakes
- Non-selective, will remove all plants not just one species

Results

- Eradication of large populations is not possible
- The existing hydrilla is building a resistance to Fluridone
- Continued treatment with Fluridone will harm native plants and increase tolerance of the hydrilla

Recommendations

- Develop lake management plans
- Stop consecutive years of Fluridone application
- Discontinue the hydrilla eradication policy on large lakes
- Conduct more research on grass carp and their removal after the hydrilla is reduced
- New herbicides need to be developed

The presentation included a discussion of the various means of aquatic plant control including mechanical methods utilizing a harvester which physically removes the majority of plants in a targeted area. Mechanical harvesters are beneficial within canals to maintain access while not adding to the build up of detritus. The drawbacks to this as an approved method for whole lake aquatic plant management

include the fact that it is only effective in smaller, confined areas, it is non-selective as to the species of plants that it removes because in removes the majority of plants in an area, and the inherent costs of purchasing, operating and maintaining a mechanical harvester.

Another method of aquatic plant control discussed included the introduction of triploid grass carp in the lakes. The drawback to this method is the long term effect these fish could have on a lake. The grass carp are effective in controlling hydrilla however, after they have devoured all of the hydrilla they begin to feed on the native, more desirable aquatic vegetation. Grass carp have the potential to denude the lake of all vegetation. Although the triploid grass carp are bred to be sterile, they can live up to 12 years which is longer than they are required for effective management of hydrilla. Various means of removing the fish from the lakes after their affective usefulness have been explored, however a successful method has not been determined.

The most cost effective and successful method of aquatic plant control is through the application of herbicides. The most common product currently used is Fluridone which specifically targets hydrilla. This product can be applied to large areas to effectively control the spread of hydrilla. One drawback to this method of aquatic plant control is that more resistant strains of hydrilla are evolving which require higher doses of the herbicide to remain effective. Dr. Allen explained that chemical companies who manufacture herbicides are currently working on the development of improved chemicals to control the resistant strains of exotic aquatic plants, without damaging the native species of aquatic plants.

Another method of aquatic plant management discussed included revegetation with desirable aquatic vegetation. The SJRWMD, FWCC and LCWA are all involved in near shore aquatic plantings as a method of minimizing exotic species of plants and improving fisheries habitat.

The Council supports the invasive plant management efforts of the SJRWMD, FWCC, and the Lake County Mosquito and Aquatic Plant Management Section. In their 2004 – 2005 funding request to the Florida Legislature the Council prepared an $800,000 funding initiative that outlined the lake restoration issues they support which included largemouth bass restocking, aquatic plant revegetation efforts, cypress tree plantings and funds to assist the Lake County Mosquito and Aquatic Plant Management Section to assist in the funding of their aquatic plant management efforts. Of the $300,000 awarded to the Council for the funding initiative, the pro-rata share of $56,250 was provided to Lake County Mosquito and Aquatic Plant Management Section.

The Council passed Resolution No. 2005-2 A RESOLUTION OF THE HARRIS CHAIN OF LAKES RESTORATION COUNCIL REQUESTING THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT TO TRANSFER $300,000 IN 2005 STATE APPROPRIATIONS TO THE LAKE COUNTY WATER AUTHORITY

FOR THE PURPOSE OF SUPPORTING REVEGETATION WITH NATIVE VEGETATION, STOCKING OF LARGEMOUTH BASS, CONTROLING EXOTIC AND INVASIVE VEGETATION, AND PLANTING CYPRESS TREES in October 2005 to transfer these funds to the LCWA for disbursement to the proper receiving agency. A copy of that Resolution is provided in Appendix 6.

2.2.4 Revegetation of Aquatic Habitat and Cypress Tree Plantings

Issues: **Enhanced near-shore aquatic vegetation can provide improved fisheries habitat and water quality. The planting of cypress trees can improve wetlands and wildlife habitat.**

Actions: **The Council supports the revegetation of near-shore aquatic habitats and the planting of cypress trees. The Council was awarded $37,500 in State appropriations from the Florida Legislature in 2005 to assist aquatic habitat revegetation efforts and $18,750 to assist in cypress tree plantings.**

Another lake management practice discussed was the improvement of fisheries habitat and improved water quality by increasing the amount of littoral zone plant coverage. Spawning of many fish including game fish occurs within the littoral zone or near-shore portions of lakes. The drought experienced in north-central Florida during the late 1990s through the early 2000s caused lower lake levels that greatly reduced the amount of littoral plant coverage in many of the area lakes, and increased the nuisance and exotic aquatic plant species. Improvement of fisheries habitat and improved water quality can be accomplished by increasing the littoral zone plant coverage. Spawning of many fish including game fish occurs within the littoral zone or near-shore portions of lakes.

The Council was previously presented with information on the relationships among littoral vegetation, increased fish production, and improved water quality. Included in that information was a study conducted by the SJRWMD, which addressed restoration issues for Lake Griffin. The study utilized Geographic Information Systems (GIS) mapping technology and included information on water clarity and light availability for aquatic vegetation, bathymetric data that indicated areas suitable for aquatic planting, and the potential for resuspension of sediments in the lake littoral zones. Also included in the study were estimates of soft sediment thickness in the littoral zones, which is necessary information for dredging cost estimates. The study identified areas in Lake Griffin that could be made suitable for planting desirable vegetation, with a minimum amount of soft sediment removal, generally less than two to three feet in depth. It was determined that a volume of sediments covering approximately 300 acres would need to be removed in order to achieve the goal set by the Council of 10% to 15% aquatic plant coverage in the lake. The study was conducted utilizing the light conditions within Lake Griffin in 2002. Possibly based on increased rainfall the area experienced in 2003, light conditions were determined to have increased the volume of sediments that would be required to be

removed cover an area of approximately 800 acres. Additionally, revegetation efforts completed by the FWCC included the planting of approximately 500,000 littoral plants in lakes Beauclair, Dora, and Yale.

Additional information previously reviewed by the Council included field surveys/inventories of existing submerged aquatic vegetation in Lake Griffin. The survey identified areas of eelgrass or tape grass (*Vallisneria americana*), southern naiad (*Najas guadalupensis*), coontail (*Ceratophyllum demersum*), and Illinois pondweed (*Potamogeton illinoensis*). Limited populations of hydrilla (*Hydrilla verticillata*) were also identified in the lake. Other species of aquatic plants located within the lake included knot grass (*Paspalum distichum*), spatterdock or cow lilies (*Nuphar lutea* subspecies *advena*), cattails (*Typha* sp.), duckweed (*Lemna valdiviana*), pickerelweed (*Pontederia cordata*), wild taro (*Colocasia esculenta*), soft rush (*Juncus effusus*), duck potato (*Sagittaria lancifolia*), and primrose willow (*Ludwigia* sp.). Of these plants, hydrilla is classified as a non-native invasive species, which through excessive propagation crowds out the more desirable native species that provide improved fisheries habitat and increased fish production.

The summary of the plant surveys and inventories data reviewed indicates that although the abundance of aquatic plants is improving in the Harris Chain of Lakes due to improved water quality and clarity, plant coverage is less than the desired percentages required to support thriving sport fish habitat. The SJRWMD, FWCC and LCWA are all actively involved in aquatic plant revegetation for improved water quality and sport fish habitat.

The Council supports near-shore aquatic revegetation as a means of water quality improvement and habitat restoration. In their 2004 – 2005 funding request to the Florida Legislature the Council prepared an $800,000 funding initiative that outlined the lake restoration issues they support which included largemouth bass restocking, aquatic plant revegetation efforts, cypress tree plantings and funds to assist the Lake County Mosquito and Aquatic Plant Management Section to assist in the funding of their aquatic plant management efforts. Of the $300,000 awarded to the Council for the funding initiative, the pro-rata share of $37,500 was provided to support revegetation of aquatic habitat efforts.

The Council had also previously received information on the benefits of improved wetland habitat through the planting of cypress trees. It was discussed that cypress trees play a key role in the uptake of nutrients in wetland systems and improve wildlife habitat. Areas that would benefit from this restoration effort include the Lake Apopka Marsh Flow-way, Emeralda Marsh and the Lake Apopka North Shore Restoration Area. The North Shore Restoration Area along the northern portion of Lake Apopka was formerly used for muck farming operations. The SJRWMD has since purchased the property and is in the process of restoring the area into a series of marshes and wetlands to improve the quality of water discharged from the former farms and into Lake Apopka.

The Council supports cypress trees plantings and wetland restoration efforts of the SJRWMD, FWCC and LCWA. In their 2004 – 2005 funding request to the Florida Legislature the Council awarded $18,750 to assist in cypress tree planting and wetland restoration efforts. The Council passed Resolution No. 2005-2 (Appendix 6) in October 2005 to transfer these funds to the LCWA for disbursement to the proper receiving agencies.

2.2.5 Sport Fish Restocking

Issues: **Sport fish restocking efforts will provide both recreational benefits and economic growth for the area.**

Actions: **The Council supports the sport fish restocking research and the efforts of the Lake County Water Authority and University of Florida. The Council was awarded $187,500 in State appropriations from the Florida Legislature in 2005 to assist in Florida largemouth bass restocking efforts.**

Throughout the year the Council received updates and information on the benefits of restocking the Harris Chain of Lakes with Florida largemouth bass by the University of Florida and the FWCC.

During the Spring 2005, Daniel Canfield, Ph.D. of the UF and TAG member to the Council conducted largemouth bass restocking in Lake Griffin with the aid of graduate students from the university. In his regular updates to the Council he explained that the majority of the bass relocated were obtained from the ponds and lakes at the Orlando International Airport. He said that a directive to do so was approved by the Orange County Board of County Commissioners and that airport personnel believed reducing the number of fish in their lakes would reduce the number of bird strikes on aircraft.

The efforts included the relocation of approximately 4,230 bass, of which over 1,000 were in the 10 – 12 inch range and over 300 were 18 inches or larger. Dr. Canfield explained that all of the fish were marked and some those greater than 10 inches were fitted with special tags for future identification. The LCWA provided $130,000 for the relocation efforts.

In his May 2005 update to the Council, Dr. Canfield said that recent fish counts conducted by the UF indicated that approximately 10% of the bass in Lake Griffin were the relocated fish and they estimated the entire bass population in the lake to be 44,000. He explained that this population is approximately 4.5 bass per acre and studies conducted in the 1980s indicated that 8 to 11 bass per acre appeared to be the average for lakes throughout the state. Dr. Canfield also discussed the economic impacts of successful bass populations quoting ranges of values saying replacement costs for the bass may be $70,000 to $131,000 and the economic return may be $50,000 to $780,000 annually, not including the professional bass tournaments.

During their June 2005 meeting the Council was provided an update on the renovation of the Richloam State Fish Hatchery by Rick Stout, a scientist with the FWCC and Manager of the Richloam facility. Highlights of the presentation included;

- Originally constructed in 1965 – 1966
- Largest facility in the State for indoor spawning
- They have full control over water temperature, air temperature and light
- There are six – 80 foot flowing channels or "raceways" for the fish
- The facility filters 6,600 gallons per minute which is recycled for use at the facility
- The facility can produce 1.5 million large mouth bass fingerlings per year in the 3.5 to 4 inch size class
- They breed nine species of fish including Florida largemouth bass, channel catfish, bluegill, shell crackers, and white catfish
- They produce 300,000 channel catfish per year
- Florida largemouth bass are a unique strain
- The facility allows them to work with fish genetics

Mr. Stout explained that they are developing a specific feed for bass that will produce larger and healthier fish because the current feed produces bass with fatty livers that do not survive very well after being released. The new feed they are developing will have an improved balance of amino acids and fat would allow the fat to be burned up as energy and not be stored in the liver. He said the improved feed and producing larger fish may increase the success rate of the released fish to over 30%; currently the success rate is about 20%. Mr. Stout explained that the success rate will also be increased by spawning the bass a couple of months earlier than normal so when they are released, the advanced fingerlings will feed on the shad fry. Renovation of the Richloam facility was expected to be completed by September 2005 and begin releasing fish in the Spring 2006.

Another issue discussed regarding bass restocking involved the genetic strain of bass to be released into Florida lakes. During the July 2005 meeting John Benton, a biologist with the FWCC told the Council in the future tighter controls will be in place that regulate the genetics of bass released into the lakes, in an effort to populate the lakes with pure Florida largemouth bass. Over the years bass from outside the State have been used in restocking, which has diluted the Florida strain and the Florida largemouth bass are the most sought after by anglers. He said that permits can be issued for bass restocking, so long as those receiving the permits adhere to the rules. During the October 2005 meeting Mr. Benton explained that the FWCC will be implementing new rules and regulations to protect the genetic strain of Florida bass. He said that the bass that the FWCC have been stocking over the past five to seven years have been from Florida brood stock, but in the past some of the lakes have been stocked with northern bass. Mr. Johnson also said that the

FWCC and the University of Illinois are completing a bass survey for lakes in the entire state of Florida.

Throughout the course of the year the Council was also provided information on fish counts, surveys and the status of aquatic vegetation. Based on the information presented, the Council supports the efforts of the FWCC on bass research and endorses sport fish restocking as a beneficial lake management practice. In their 2004 – 2005 funding request to the Florida Legislature the Council prepared an $800,000 funding initiative that outlined the lake restoration issues they support which included largemouth bass restocking, aquatic plant revegetation efforts, cypress tree plantings and funds to assist the Lake County Mosquito and Aquatic Plant Management Section to assist in the funding of their aquatic plant management efforts. Of the $300,000 awarded to the Council for the funding initiative, the pro-rata share of $187,500 was provided for bass restocking efforts. The Council passed Resolution No. 2005-2 (Appendix 6) in October 2005 to transfer these funds to the LCWA for disbursement to the proper receiving agency.

2.2.6 Potentially Toxic Algae

Issue: Potential human health concerns and poor water quality associated with algal blooms.

Actions: The Council recognizes the potential human health concerns associated with algal blooms and initiated a program to educate local health professionals on this issue.

Another issue discussed throughout the year was the potential health concerns that have been associated with infections that can be attributed to the release of biotoxins and neurotoxins from cyanobacteria or blue-green algae.

As background to this issue, during the July 2003 meeting a presentation was given by Dr. Ritchie Shoemaker, M.D., a medical expert in the field of biotoxic and neurotoxic illnesses. His research indicated that there are potentially toxic releases from algae found in several lakes in the chain, primarily from *Cylindrospermosis* and *Microcystis* – cyanobacterium or blue-green alga. Dr. Shoemaker's presentation also included information on *Pfiesteria* which is toxic dinoflagellate found primarily in marine environments and is associated with algae blooms and red tide. Inputs of metals, especially copper, have upset the food chain and have allowed the propagation of algal blooms. When copper, which has been used as a fungicide in area agricultural operations is introduced into the water, it kills the organisms that the *Pfiesteria* lives on (consumes) and forces it back into the water column in search of food, thus causing a "bloom." Through the food chain process, the biotoxins can be taken in by small fish near the algae they feed on. Larger fish eat the smaller fish and eventually game fish that may then be eaten by humans can become infected with the biotoxins that can reach high concentrations. Symptoms of exposure to these biotoxins may include numbness and tingling, nausea, vomiting, headache,

weakness, irregular heartbeat, prolonged difficulty with short-term memory, muscle aches, diarrhea, abdominal pain, shortness of breath, and skin problems. He believed these symptoms may have been misdiagnosed in the past as depression, Chronic Fatigue Syndrome, Fibromyalgia, Irritable Bowel Syndrome, Multiple Sclerosis, Sick Building Syndrome, Endometriosis, and learning disabilities to name a few. Dr. Shoemaker expressed his concern that the collection of symptoms is often misdiagnosed and patients have suffered from many of these symptoms for ten years or longer.

Additionally, during the July 2004 meeting Dr. Andrew Reich, the Aquatic Toxins Program Coordinator with the Bureau of Community Environmental Health – Florida Department of Health (FDOH) made a presentation. Dr. Reich explained that Harmful Algal Bloom toxins are harmful in minute (picogram) doses, they have no taste or smell, and they are very difficult to eliminate. An outbreak of cyanobacteria or blue-green algae in salt water is known as Red Tide, which can be associated with respiratory problems in people and with large fish kills. In fresh water they consist of Cyanobacterium including; *Microcystis* and *Cylindrospermopsis*. The FDOH has conducted studies which indicate that there are certain forms of cancer in humans, which can be triggered by exposure to blue-green algae. People who have reactions to Red Tide are often those who are sensitive to irritants or pulmonary disease.

Routes of exposure are via the skin, inhalation or ingestion. Mr. Reich described studies in the Chesapeake Bay where *Pfiesteria* was found to be predatory evidenced by lesions on fish that have been caused by *Pfiesteria* attacking them. He also said that the reporting developed by the Centers for Disease Control (CDC) has been centered on the issues with *Pfiesteria* and that it does not cover Red Tide or blue-green algae exposures. Mr. Reich said that the CDC is developing a reporting form that will cover other types of exposures, in order to help gather the information necessary to better assess the risks.

During the December 2004 Council meeting the Council heard another presentation on this issue by Dr. JoAnn Burkholder, an Associate Professor of Aquatic Botany and Marine Sciences at North Carolina State University. A summary of her presentation is presented below and the complete presentation is provided in Appendix 7.

Dr. Burkholder began her presentation by saying that she was going to explain the differences among populations within the same species of harmful algae. Her studies indicate that different strains (populations within the same species) display different responses to environmental conditions that include the nutrients in the water column (e.g. ammonia, nitrates, and urea), water temperature and other factors. She said that due to genetic variations within the same strain, it is impossible to predict how they will react in different environmental conditions. Dr. Burkholder also said the concept of genetic variability within the same species is one that the scientific is slow to accept. She explained some of the different traits within these

strains including; toxin production, toxicity, morphology, DNA, life history, growth rates, and nutrient metabolism or how the organism uses nutrients such as nitrogen and phosphorus.

She presented the Council with reproduction data of crossed strains which demonstrated the reproductive variability in crossing of three different strains of a toxic dinoflagellate in four combinations of pairs. The variability of the offspring production rates and the viability of the offspring varied greatly. Her point was that if only one or two strains of the same species were crossed, a firm understanding of the species could not be gained. She said that many strains must be studied to understand the species.

Dr. Burkholder's data included response to nitorgen depletion / replenishment which demonstrated that different strains in the same species respond dramatically different in both the numbers of individuals and their growth rates. She explained that in order to understand the cyanobacteria in the area lakes, it must first be determined what the dominant strain is during algal blooms; how they respond to nutrient pollution and how they produce toxins. The data provided by Dr. Burkholder also demonstrated that two strains of *Pfiesteria* that responded differently to fish excreta (i.e. waste). The non-inductible (non-toxic) strain had a very weak chemosensory attraction to the excreta while the toxic strain had a strong attraction.

Dr. Burkholder's presentation moved towards marine toxic dinoflagellates which can have chronic and sub-lethal impacts on mammals. These impacts include severe headaches, joint pain, muscle spasms, changes in blood pressure, nausea, vomiting, diarrhea; central peripheral autonomic nervous system dysfunction; reversible short-term memory loss, learning disabilities; malignant tumors, comprised immune systems; and dysfunction of the endocrine system. She went on to describe a series of tests that were conducted using 17 clones of a toxic dinoflagellate from an identical strain that produced toxins with various levels potency. A single clone of the original 17 was used to produce 15 sub-clones of the same strain. The sub-clones also produced toxins with a wide variability of potency.

Dr. Burkholder's presentation then moved on to fresh water toxic cyanobacteria which may be found in the area lakes. She described some of the chronic and sub-lethal impacts that toxic cyanobacteria can have on mammals with possible symptoms including nausea, vomiting, hemorrhaging, asthma-like symptoms; central nervous system dysfunction; malignant tumors (hepatic, abdominal, uterine and thoracic), and leukemia. She briefly talked about medical issues and deaths in humans associated with ingestion saying there are many recorded cases. Ingestion of toxic algae have produced gastrointestinal and hepatic illnesses through potable water supplies in towns along the Ohio River (1931), a city in Zimbabwe (1966) and certain villages in China (1990s) where there have been cases of hepatic tumors. She explained that one of the best epidemiological studies conducted on toxic exposure was on the Aborigines in Australia (1979) where 140 children and 10 adults suffered diarrhea, severe kidney and liver (hepatic) damage. She explained that 70% of those

people exposed to the toxin required intravenous therapy with some who suffered hypovolaemic or acidotic shock. Dr. Burkholder went on to say that South America has also had many cases of toxic exposures including Brazil (late 1980s) where 88 people, most of whom were children, died as a result of drinking water that contained dense blooms of *Microcystis*. Another instance known as Caruaru Syndrome occurred when 117 dialysis patients were given water from the public drinking water supply which contained a *Microcystis aeruginosa* bloom. As a result, 100 of those patients suffered acute liver failure and 49 of them died.

Dr. Burkholder then explained that one of the major difficulties with studying these organisms is that variability within the same strain is often dramatic. In the laboratory some strains produce toxins within a given environment and when that same strain is moved to an environment that has been reproduced to be identical to the first, they produce no toxins. The reasons for these anomalies are poorly understood. She said it is known that environmental factors can influence toxin production but not always consistently. Time is another variable that can affect toxin production where a strain that had previously produced toxin, may stop producing it over time. Dr. Burkholder said that the genetic variations of these organisms may also affect their ability to produce toxins however, only a limited amount of research has been conducted on their genetic makeup.

Dr. Burkholder also discussed *Cylindrospermopsis* that is present in area lakes saying tests have shown that due to genetic variations, 9 out of 24 colonies would be toxic. One of the things that has been discovered about some cultured strains of *Cylindrospermopsis raciborskii* is that they produce toxins outside their optimum conditions of light and temperature which for growth is 35ºC (95ºF) and for toxin production is 20ºC (68ºF). She also said that phosphorus is not the only nutrient that affects toxin production but that nitrogen is also very important. She explained that although cyanobacteria can fixate nitrogen from their environment, the organism uses a large amount energy to do so. Therefore, the availability of nitrogen in the form of ammonia (NH_4) influences the growth and toxin production of these cyanobacteria. She went on to say the amount of phosphorus and nitrogen required to stimulate algal blooms is relatively small compared to the amount that is available in most lakes.

Dr. Burkholder presented a graph that showed when the N:P ratio (the amount of nitrogen relative to phosphorus) was reduced, so did the occurrences of red tides and algal blooms. She explained that although this appears to be the case, these ratios change very slowly over time. Dr. Burkholder said that even after the sources of nutrient input are controlled and reduced, large quantities of these nutrients are contained within the bottom sediments. Therefore, the larger the volume of nutrient-rich sediments in a lake, the longer it takes for the net N:P ratio to be reduced. Additionally, these nutrients can be resuspended in the water column through the action of wind and waves, which makes them available for algal blooms.

The presentation then moved onto *Pfiesteria*, a toxic dinoflagellate found in marine environments saying that organism has the ability to attack and "eat" the flesh of fish. She explained that *Pfiesteria* species can cause both surficial nonfocal and deep focal lesions on fish. *Pfiesteria* can cause death in fish due to the effects of the toxin it produces and the physical damage to the fish because of the lesions it can cause. Dr. Burkholder went on to explain that in the laboratory when *Pfiesteria* was allowed to physically attack fish, the mortality rate of the fish was greater than 90%. Additionally, when the water in the experiments was strained or filtered to remove the organisms, the toxin alone had the ability to kill fish 20 to 40% of the time, respectively. Humans exposed to aerosols (airborne particles) of the toxic fish killing cultures or to toxic *Pfiesteria* outbreaks, have suffered impacts to the central nervous system and difficulties with memory.

In summary, Dr. Burkholder stressed that not all strains of these algae are toxic and just because *Microcystis* is present, it is not necessarily of a toxic strain because there are also benign strains. She said that researchers face many challenges in the study of these organisms. She added when only one or a few strains are studied, there are different and often opposite interpretations from the data. Within the toxigentic species that have been examined, significant differences among strains are the norm; where the differences include morphology, life history, reproduction, nutrition, toxicity and others. She said that the underlying reasons for these differences are generally unknown.

Dr. Burkholder's recommendation to the Council was that just because algal blooms occur in the area lakes; don't automatically assume they are toxic. She said the toxic species are only potentially toxic and just because *Cylindrospermopsis* or *Microcystis* is present in a bloom, it could be benign. She also said that if the Council were in a position to educate the public or the press; that they should caution people not to assume a bloom is toxic or dangerous until the proper testing has been done. Dr. Burkholder then opened the floor for questions.

During the June 2005 Council meeting, Dr. Andrew Reich (FDOH) provided an update to the Council on activities involving cyanobacteria. Dr. Reich said that he had been working with Russ Melling of the Lake County Health Department and Council Secretary Thomas Cook, M.D. on a public education program regarding the issue of cyanobacteria in area lakes. Over the past year he explained that they have been working with the county health departments which included assembling a Public Health Technical Advisory Committee who have been developing generic response plans for harmful algal bloom conditions. This plan will provide guidance to local authorities for actions to be taken when algal blooms occur in recreational waters. The Technical Advisory Committee is being spearheaded by the Florida Wildlife Research Institute in St. Petersburg who will hold a conference in September during which they will adopt some of the recommendations in the plan. Dr. Reich explained that once the recommendations are adopted, they will be provided to participating county health departments who can act on them based on

their specific needs. He said the FDOH will continue to work with the counties to develop specific action for their situations.

Dr. Reich said the FDOH is also reviewing their regulation of fresh water public beaches. He explained that they are currently selecting a number of fresh water recreational areas around the State to conduct studies on how blue-green algal blooms affect people in those areas. He also said that they are working with the CDC to study the mechanisms of exposure to people who recreate in and around lakes experiencing algal bloom conditions. Dr. Reich explained that the FDOH is not only coordinating with the CDC to conduct the study in Lake County, but also with the FDEP, LCWA, Lake County Health Department, Mote Marine Laboratory and others because there is a lot of information available in the county on cyanobacteria. He said that the FDOH Internal Review Board has approved the study with the use of volunteers and it is currently pending approval of the CDC Internal Review Board.

Dr. Reich went on to explain the study by saying volunteers will be provided personal air monitors that they will wear while water skiing, jet skiing, fishing, etc. to measure any aerosol exposure to toxins in the algae that may be present. He said after the volunteer, who has been explained the risks and consented to the study, has been recreating around a bloom for an hour or so; they will submit to a blood test along with an interview to determine it there are any symptoms. Additionally, water samples will be collected in the same areas where the volunteers are in the water. Dr. Reich believed the initial study will be conducted at Hickory Point on Little Lake Harris. No further updates on the specific activities of the FDOH on the above discussed matters were provided during the period of this report.

In support of this potential health issue the Council requested that Council Secretary Thomas Cook, M.D. coordinate a program to educate local medical professionals on the aspects of algal blooms. It was decided that a presentation would be made to the Lake County Medical Society during one of their quarterly meetings on the "Potential Effects of Blue-Green Algae Toxins to Humans" by Mike Perry (LCWA). Additionally, a series of articles on the subject would be written for publication in the medical society's quarterly publication, The Monitor. The four articles are to be written by Secretary Cook, Mr. Perry, Dr. Andrew Reich and Dr. JoAnn Burkholder. Each of those individuals has agreed to write one of the articles. These efforts of the Council are ongoing.

Additionally, the issue of water quality and cyanobacteria monitoring was discussed throughout the year. It was determined that the LCWA who had been performing water quality monitoring in the past is concerned with their liabilities associated with the human health aspect of the cyanobacteria monitoring. It is the consensus of the LCWA Board of Trustees (Board) that cyanobacteria monitoring is an issue involving public health and should thereby be monitored by the local health department or the FDOH. The Council agreed.

The Council recognizes the potential human health concerns associated with algal blooms and initiated a program to educate local health professionals on this issue. During the October 2005 Council meeting a motion was passed to include $250,000 in their 2005 – 2006 Legislative Funding Request for cyanobacteria monitoring, to be used in cooperation with the FDOH.

2.2.7 Rough Fish Harvest

Issue: The reduction of phosphorus and associated improvement of water quality through the removal of rough fish from the lakes.

Actions: The Council continued to support this experimental management technique as a possible method of water quality improvement.

Gizzard shad have been identified as an abundant species of fish that affects water quality within key lakes of the Harris Chain of Lakes. The rough fish harvest appears to provide phosphorus reduction by removal of the fish. The Council is awaiting the results of an independent evaluation of the information presented by SJRWMD before deciding whether to endorse the rough fish harvest as a means of water quality improvement.

The lake management issue with gizzard shad is that they are benthivorous, meaning they are bottom feeders and consume sediments in search of other food. The sediments contain large quantities of phosphorus and other nutrients that have settled to the bottom and shad eat the sediments. It was explained to the Council that the aqueous nature their excretions make the phosphorus more bioavailable in the water column. The greater bioavailability of phosphorus leads to the emergence of sometimes exotic or invasive aquatic vegetation and algal blooms.

In March 2005 the Council was presented with information on gizzard shad by Dr. Mike Allen of the UF Fisheries and Aquatic Sciences Department. An outline of the presentation given by Dr. Allen to the Council is provided below. The complete presentation, along with a presentation he gave on hydrilla management is provided in Appendix 8.

<u>Gizzard Shad</u>

- Important prey species for predator fish such as black bass and crappie.
- Often dominate fish biomass in hypereutrophic lakes
- Often dominate predator diets
- Found in large, eutrophic and hypereutrophic Florida lakes
- The number of fish increases with increased chlorophyll concentrations

Shad hatchlings outgrow bass hatchlings due to;

- Increased phosphorus accelerates their growth
- They can out compete predator fish for zooplankton

- They can feed either from the water column or bottom detritus

Impacts of Gizzard Shad

- Shad that are 30 to 40 millimeters (mm) in length can begin to eat detritus and bottom sediments
- May increase nutrients in the water column by resuspension of sediments
- Shad excrete nitrogen (N) and phosphorus (P) that are highly available to the water column
- Reducing shad abundance could influence water chemistry and clarity

Shad management efforts;

- Summary of gill netting activities in Lake Apopka
  - There is anecdotal evidence of reductions in phosphorus reductions in lakes Griffin, Apopka and Denham
- The use of a 4" gill net leaves shad of breeding size behind (approximately 8")

Gizzard shad harvest on Lake Dora

- Harvesting activities began on March 1st
- Evaluation of sport fish populations will be conducted over the next year on lakes Dora, Beauclair, Eustis and Harris
- Discussion of shad size vs. bycatches

After harvest at Lake Dora

- Evaluate gizzard shad population response
- Evaluate changes in sport fish abundance
- Compare to lakes with no harvest
- Results will show how commercial harvest impacts shad populations and lake trophic processes
- Bycatch impacts will be identified

Another method of gizzard shad management suggested to the Council included stocking the lakes with advanced bass fingerlings. This method involves the breeding of largemouth bass earlier than their natural season and allowing the fry to grow to three to four inches before being released into the lakes. The release of the advanced fingerlings would be timed to the initial spawning of the gizzard shad, such that the bass fingerlings would feed on the shad fry and out compete them in the lakes.

In his presentation to the Council, Dr. Allen explained that in order to have a successful bass restocking program there must be habitat restoration. As the water quality in a lake improves, macrophytes (aquatic plants) will begin to flourish and lakes which have a good amount of vegetative cover have very productive sport fish populations. Dr. Allen went on to say that increased bass populations in a lake will

help control shad populations by the bass eating a percentage of the smaller shad. He said that studies of hybrid striped bass appear to have an impact on shad populations.

The SJRWMD continued to provide information on gizzard shad harvests throughout the course of this reporting year. During the May 2005 Council meeting it was reported that the shad harvesting efforts of the "winter" had been completed for the targeted lakes in the Harris Chain. The harvesting removed a total of 1.15 million pounds of gizzard shad including 750,000 pounds from Lake Apopka, 280,000 pounds from Lakes Beauclair and Dora, and 100,000 pounds from Lake Griffin.

The UF Fisheries and Aquatic Sciences Department is conducting a study on the effects of gizzard shad removal as a method of managing phosphorus in lakes. The Council will review the report and additional data on this measure, as they become available. Phosphorus reduction in the Harris Chain of Lakes through the harvesting of gizzard shad is still considered an experimental or research demonstration project. The Council supports the efforts of the SJRWMD and the UF Fisheries and Aquatic Sciences Department in gizzard shad harvesting.

2.2.8 Lake Apopka Marsh Flow-way System

Issue: **Are the marsh flow-ways an effective method for phosphorus reduction of nutrient-rich waters?**

Actions: **The Council continued to review the effectiveness of the flow-way at removing suspended solids, nitrogen and phosphorus and is closely monitoring the dissolved oxygen concentration of the water discharged, which is below desirable levels.**

In November 2003 the SJRWMD began operation of the Lake Apopka Marsh Flow-way located near the northwest portion of Lake Apopka. The flow-way is constructed on former agricultural land that had been purchased by the SJRWMD and is located at the southern end of the Apopka-Beauclair Canal. Water from Lake Apopka enters the flow-way via the canal and then passes through a series of treatment cells where natural biological processes, along with the settling of nutrients like phosphorus and other suspended solids takes place. The "treated" water is then pumped back into the canal where the majority of the water flows back into Lake Apopka and a portion of it enters the Harris Chain of Lakes through Lake Beauclair.

Cumulative data for the entire period of operation from November 2003 through mid-September 2005 indicate that the flow-way has removed 1.37 tons (1.24 metric tonnes) of phosphorus, 200 tons (183.5 metric tonnes) of nitrogen and 7,300 tons (6,628 metric tonnes) of total suspended solids. For comparison purposes, if the total suspended solids removed by the flow-way through the above period were in the

form of surficial organic sediments, they would equal approximately 1,970,246 cubic yards of sediment.

Average operating efficiencies for the flow-way indicate that it is removing approximately 30% of the total phosphorus, 40% of the total nitrogen and 95% of the total suspended solids in the water treated from Lake Apopka. Since the flow-way began operation there is a reported net decrease in the amount of phosphorus discharged. However, during initial operation of the facility and in response to Hurricane Charley and Hurricane Frances in 2004, there were net increases of phosphorus discharged from the flow-way.

In March 2005 one of the cells of the flow-way was modified to include a portable alum injection system. Alum or aluminum sulfate is a compound that can be applied directly to water. Dissolved and particulate phosphorus is bound or "adsorbed" to the alum, which reduces the bioavailability of the nutrient. The bound phosphorus and alum settles to the bottom of the water column where it remains as inert floc. This system was installed so that it may treat water stored in an area north of the flow-way, as a result of the hurricanes of 2004 and increased rainfall in the summer of 2005. It is estimated that approximately 1 ton (0.96 metric tonnes) of phosphorus has been removed by this effort that would have otherwise been discharged into the Apopka-Beauclair Canal.

Another modification made to the flow-way during the period of this report was the installation of an additional pump to increase the volume of water that can be discharged from the facility. Previously the facility was operated with three electric pumps that discharge 50 cubic feet per second each. A fourth electric pump with a capacity of 37.5 cubic feet per second, serves as a backup to the primary pumping system. Normal operation of the facility discharges 150 – 160 cubic feet of treated water per second to the Apopka-Beauclair Canal. With the installation of the additional pump, the facility can be operated to discharge water up to 200 cubic feet per second. Approximately 7.5% of the water released from the flow-way enters Lake Beauclair and the Harris Chain of Lakes. The other 92.5% of the treated water is returned to Lake Apopka.

An issue of concern for both the SJRWMD and the Council involved the Dissolved Oxygen (DO) levels of the water discharged from the flow-way into the Apopka-Beauclair Canal. Marshes and swamps typically have very low DO in their waters due to their biological processes. The FDEP water quality standard for DO in Class III Waters of the State is 5.0 milligrams per liter (mg/L). At issue is the fact that fishes and aquatic animals generally cannot survive in water with DO below 2.5 mg/L. A concern of the Council is that if a large volume or "slug" of low DO water, below 2.5 mg/L were released from the Lake Apopka Marsh Flow-way, it could cause a fish kill downstream.

The flow-way being a marsh system produces water with low DO, below the State standard. However, water quality data indicates that low DO is primarily found in

the immediate vicinity of the discharge pumps and improves to above the State standard as it moves down the Apopka-Beauclair Canal. Vivian Garfein, the FDEP District Director was contacted to discuss the FDEP's stand on this issue. She said that it was anticipated by the FDEP when they issued the operating permit for the Lake Apopka Marsh Flow-way that low DO may be an issue. However, the FDEP decided to not take any action on the matter and will continue to review the data as it becomes available.

Based on these issues, the Council will continue to review the operational data prior to giving the Lake Apopka Marsh Flow-way their endorsement. With the exception of DO, the Council is encouraged by the nutrient removal and water quality data received to date.

2.2.9 Total Maximum Daily Loads and Pollution Load Reduction Goals

Issue: The FDEP has set guidelines for Total Maximum Daily Loads and PLRGs as they relate to water quality.

Actions: The Council agreed to continue to monitor the Total Maximum Daily Load and Pollution Load Reduction Goal programs.

The FDEP and SJRWMD provided information to the Council regarding Total Maximum Daily Loads (TMDLs) and Pollution Load Reduction Goals (PLRGs) guidelines and implementation. PLRGs are similar in intent to TMDLs and are defined as an estimated numeric reduction in pollutant loads, which would be required to preserve or restore water quality consistent with the applicable State water quality standards. Each of the water management districts in Florida was required by the FDEP to develop PLRGs for pollutants in priority water bodies within their boundaries.

Barbara Bess, an FDEP Watershed Management Coordinator and member of the Technical Advisory Group to the Council provided updates throughout the year on the progress of the TMDL Program. During the April 2005 meeting she explained the TMDL process as a 5-year cycle that began with acquiring water quality data from all the various agencies to assess the Ocklawaha River Basin. From the assessment the FDEP assembled a list of Impaired Waters, targeted for the TMDL Program and forwarded that list to the Environmental Protection Agency (EPA). The Verified Impaired Waters List was returned by the EPA and the FDEP began developing the TMDLs for the most critical water bodies first. Ms. Bess added that the EPA has allowed 12 years to develop TMDLs for all water bodies in the State.

For the past year the FDEP has been meeting with local governments and stakeholders to develop a Basin Management Action Plan (BMAP) to implement the TMDL Program. Ms. Bess said that due to the Impaired Waters of the Ocklawaha River Basin, the TMDLs and BMAP are being developed first. Once the BMAP is complete they will get local government officials to approve it, then it will be the

responsibility of local governments to provide funding to implement the primarily stormwater management projects to meet the TMDLs. At the end of the first 5-year cycle a reassessment of the water quality, projects, and program goals will be conducted and adjustments made accordingly The 5-year cycle will repeat until all the goals of the program are met.

The presentation also focused on the many hurdles to overcome with local governments and future development to implement projects and Best Management Practices (BMPs) to meet the goals of the program. It was explained that it the purpose of the Basin Working Groups and development of the BMAP is to determine a course of action and who is going to pay for the projects.

Interim PLRGs for phosphorus for six of the major lakes in the UORB including lakes Beauclair, Dora, Eustis, Griffin, Harris, and Yale, were developed by the SJRWMD. The recommended PLRGs for phosphorus were determined by calculating the difference between the current phosphorus loads within the lakes and the reduced loads needed to restore the lakes to their historic conditions. The historic phosphorus concentrations of the lakes were estimated through a review of existing conditions in reference lakes and modeling of historic conditions in the basin. Target phosphorus concentrations were calculated by the SJRWMD utilizing the state water quality standard for transparency as set forth in Section 62-302.530 of the Florida Administrative Code (F.A.C), which provides for a 10% increase in transparency for surface water bodies.

Upon completion of PLRG development the FDEP utilized the recommended load reductions to develop TMDLs for all of the lakes in the Harris Chain of Lakes except for Lake Weir. The 10 year average phosphorus concentrations and annual loads were determined for each lake and then target phosphorus concentrations were estimated using this information. The target concentration represents the total phosphorus concentration at which phosphorus loading to the lakes will achieve the load reduction necessary to meet the TMDL and to restore water quality consistent with the applicable state water quality standards. The TMDLs were adopted by rule and can be found in Chapter 62-307, F.A.C.

The current levels and interim recommendations for external total phosphorus (TP) loads for the lakes are provided in the table below:

Lake	External Phosphorus Load (pounds/year)			Reduction Needed
	Current TP Load	TMDL	Target TP Concentration (ppb)	
Beauclair	46,746	7,056	**32**	85 %
Dora	39,690	13,230	**31**	67 %
Eustis	35,500	20,286	**25**	43 %
Griffin	79,121	26,901	**32**	66 %
Harris	26,915	18,302	**26**	32 %
Weir	-	-	**-**	-
Yale	3,160	2,844	**20**	10 %

Information provided by the FDEP for informational purposes only. A TMDL for TP has not been developed for Lake Weir.

The Council supports the efforts of the FDEP and the water quality improvements the TMDL program will bring. The Council will continue to monitor the implementation of PLRGs and the TMDL Program.

2.2.10 Industrial, Wastewater, and Stormwater Impacts

Issues: **The potential for discharges and subsequent impacts to the Harris Chain of Lakes and especially human health from industrial, wastewater and stormwater impacts.**

Actions: **The Council supports the continued efforts of the City of Leesburg Department of Environmental Services in their reorganization and upgrading of facilities.**

Throughout the period of this report the Council received updates on the efforts of the City of Leesburg to upgrade their wastewater conveyance and treatment facilities through Councilman Bob Kaiser. The City constructed a new wastewater treatment plant and has completed compliance related rehabilitation of the Canal Street Plant. The City of Leesburg is also upgrading other facilities including lift stations and manholes, and is addressing other issues that need to be met in order to increase the operating efficiency of their sanitary system and to minimize discharges via overflows and faulty lines. The Council continued to support the efforts of the City of Leesburg Department of Environmental Services in upgrading their wastewater conveyance and treatment facilities in order to minimize nutrient-rich discharges into the Harris Chain of Lakes.

2.3 Additional Lake Management Projects Presented and Reviewed

Throughout the year the Council was presented information on proposed projects and issues related to water quality in the Harris Chain of Lakes. Final approval of the sponsoring agencies for these projects has not been granted however, the Council recognized the beneficial impacts the projects may have. Below is a summary of the proposed projects and issues presented to the Council.

2.3.1 The Lake Beauclair Nutrient Reduction Facility

Issue: The water discharged into Lake Beauclair from the Apopka-Beauclair Canal does not meet Florida water quality standards for phosphorus.

Actions: The Council supports the efforts of the Lake County Water Authority to reduce phosphorus from the waters entering the Harris Chain of Lakes.

Throughout the year the Council was presented with information on the design and progress of the Lake Beauclair Nutrient Reduction Facility. It was explained that the TMDLs for phosphorus approved by the FDEP have a target concentration of 55 parts per billion (ppb) for Lake Apopka and 32 ppb for Lake Beauclair. The average phosphorus concentration in Lake Apopka prior to acquisition of the muck farms was 218 ppb and after the acquisition it had dropped to 148 ppb. It was further explained that the Lake Apopka Marsh Flow-way removes approximately 30% of the phosphorus in the water from Lake Apopka before it is discharged into the Apopka-Beauclair Canal. Therefore, if the average concentration of phosphorus in the water from Lake Apopka is 148 ppb and the marsh flow-way reduces it to 104 ppb, then in order to reach the target goal of 32 ppb in Lake Beauclair, there needs to be a way to reduce the concentration an additional 72 ppb. With this goal in mind, the LCWA and others are developing a nutrient reduction facility.

The Lake Beauclair Nutrient Reduction Facility is proposed to be located on a 254 acre site along the west side of the Apopka-Beauclair Canal, located just to the north of the McDonald Canal and just south of CR 48, where the SJRWMD lock and dam structure are located. The preliminary design includes two flocculation settling ponds (5 acres each) and two flocculated material drying ponds (22 acres each) to hold the material dredged from the settling ponds. It was explained that the facility will be designed to treat and discharge water at a designed flow of 300 cubic feet per second (ft^3/sec). The system will divert water from the canal where it will receive flocculation treatment with aluminum sulfate or alum, which initiates the settling of phosphorus along with other nutrients and sediments. Once the solids settle to the bottom, the water is released to the canal then continues to Lake Beauclair, north of the lock and dam.

During the March 2005 Council meeting Councilman Charles Clark, a retired Chemist, gave a presentation of the phosphorus data he collected from the SJRWMD on Lake Beauclair. Below is an outline summary of the issues he discussed and the complete presentation is provided in Appendix 9. He prepared a collection of graphs that compared total phosphorus (TP) in the various lakes to flow rates, rainfall and other factors in several of the lakes in the Harris Chain of Lakes. The series of graphs included:

TP for lakes Beauclair and Dora
TP for lakes Beauclair, Eustis and Harris
TP for lakes Beauclair and Griffin
TP in Lake Beauclair vs. Flow Rate in the Apopka-Beauclair (A-B) Canal
TP in Lake Apopka vs. the A-B Canal Above the Dam
TP in Lake Apopka vs. the A-B Canal the Dam
TP for Lake Beauclair vs. Kg. of TP Exported from the A-B Canal to Lake Beauclair
TP in Lake Beauclair vs. Rainfall
TP Above the A-B Canal Dam vs. TP Below the Dam
TP in the A-B Canal vs. Rainfall
TP Below the A-B Canal Dam vs. TP in Lake Beauclair

The focus of his presentation was the cause of episodic increases or "spikes" of phosphorus concentrations observed in Lake Beauclair. Councilman Clark presented the following conclusions:

1. "Spikes" in the TP levels observed in Lake Beauclair do not originate in Lake Apopka.
2. Significant sources of phosphorus exist south (upstream) of the dam. Much of this will be removed by the Nutrient Reduction Facility (NuRF).
3. Additional sources of phosphorus may exist north (downstream) of the dam. This phosphorus will not be removed by the NuRF project.
4. "Spikes" in TP in Lake Beauclair are not caused by "spikes" of TP existing in the A-B Canal.
5. "Spikes" of TP in Lake Beauclair appear to be weather related.
6. Surface runoff during heavy rains cannot be eliminated as a possible cause of the "spikes" observed in Lake Beauclair but the "spikes" are more probably due to re-suspension of unconsolidated material.
7. The most likely area of re-suspension contributing to the "spikes' is near the exit point of the A-B Canal, just north of the lock and dam. Some but not all of this material will be removed in the Lake Beauclair Initiative.
8. Achievement of the Total Maximum Daily Load (TMDL) Concentration of 32 parts per billion (ppb) for Lake Beauclair will be difficult unless the "spikes" can be eliminated.

Councilman Clark offered his support of the Lake Beauclair Nutrient Reduction Facility project as a beneficial method to reduce phosphorus in discharges from the Apopka-Beauclair Canal.

During the April 2005 meeting Lance Lombard, a Water Resources Project Manager with the LCWA gave a presentation to update the Council on the Lake Beauclair Nutrient Reduction Facility. An outline of that presentation is summarized below and the complete presentation is provided in Appendix 10.

Project Background

- During 1991 to 2000 the Apopka-Beauclair Canal discharged an average of 19,744 kilograms per year (kg/yr) of total phosphorus causing a persistent algal blooms in the downstream lakes
- 93% of all phosphorus going into Lake Beauclair comes from the Apopka-Beauclair Canal
- Acquisition of muck farms resulted in significant reductions in phosphorus in Lake Apopka
  - Before the acquisitions phosphorus concentrations in Lake Apopka were 218 ppb and are currently 148 ppb.
- The TMDL Target Concentration for Lake Apopka is 55 ppb
- The TMDL for TP in Lake Beauclair is 7,056 kg/yr and the Target Concentration is 32 ppb

Lake Apopka Marsh Flow-way

- Maximum discharge is 200 cubic feet per second (cfs)
- Phosphorus removal efficiency is 30%
- Provides "cleaner" water to the Apopka-Beauclair Canal, Lake Beauclair and downstream lakes
- The objective is to reach the goal of 55 ppb for total phosphorus in Lake Apopka
- There is no timeline to meet the goal

Lake Beauclair Nutrient Reduction Facility

- The design objective is to meet the TMDL Target Concentration of 32 ppb of total phosphorus for Lake Beauclair

  Phosphorus Inputs to Lake Beauclair:
  12,390 kg/yr (Apopka-Beauclair Canal) + 1,448 kg/yr (others) = 13,838 kg/yr

  TMDL (Maximum Load) = 7,056 kg/yr
  Required Removal = 6,782 kg/yr

- Proposed site is 254 acres located at the Apopka-Beauclair Canal Lock and Dam

- To provide offline Alum treatment of water removed from the canal, then collect the floc that settles out
- The project will utilize gravity flow for water into and out of the facility
- The settling ponds will be cleaned with a mini dredge to move the material to drying beds
- Construction costs are proposed to be $4,261,198.00

Expected Results

- Totally dependent on the volume of flow from Lake Apopka
- Reduce phosphorus by 8,659 kg/yr by treating 47,844 acre-feet of water
- Discharge water to within 7% of the TMDL (assuming 100 ppb mean total phosphorus)
- Increased water clarity and revegetation

Schedule

- Preliminary design is submitted
- Permitting process may take considerable time
- Need to complete the design phase
- Begin construction in approximately one year

Project Expenses

- Design and Engineering $230,000
- Construction $4,260,000 +/-
- Annual Operations and Maintenance Costs $0 to $1,500,000
- Cooperating agencies include the SJRWMD and the FDEP

It is important to note that the LCWA Board has not given final approval of this project. The Board has authorized completion of the final design of the project and making application for the permits required to build and operate the facility. Indications are that those two elements of the project will be completed in the 2005 – 2006 fiscal year and construction would begin in the following fiscal year. Upon full approval by the Board on the project, bids will be taken by private contractors to build the facility.

The Council will continue to review plans and information submitted to them for the Lake Beauclair Nutrient Reduction Facility and supports the efforts of the LCWA and others to reduce phosphorus and other nutrients from entering the Harris Chain of Lakes. After final approval is given by the LCWA Board, the Council will discuss supporting the project through a funding request to the Florida Legislature.

2.3.2 Lake Apopka North Shore Restoration Area

Issue: **More than 50 years of farming operations along the north shore of Lake Apopka has lead to environmental degradation of the lake through the discharge of excess nutrients and agricultural chemicals.**

Actions: **The Council will continue to review the evolution of projects by the St. Johns River Water Management District to restore the north shore of Lake Apopka and the environmental benefits to water quality within the Harris Chain of Lakes.**

The north shore of Lake Apopka has been historically used for farming operations. For nearly 50 years these agricultural operations known a muck farms, discharged fertilizers (nutrients), herbicides and pesticides into Lake Apopka, which caused severe environmental degradation to the lake. Since 1985 the SJRWMD in partnership with other state and local agencies, have purchased over 19,000 acres of former muck farms to better manage and control the flow of water into Lake Apopka.

Initial efforts by the SJRWMD to restore the property included the application of an alum residual flocculent over a portion of the land to act as a soil amendment. This measure will act to bind excess nutrients such as phosphorus to the soil prior to suspension in the water column. The SJRWMD also reflooded approximately 2,000 acres of the property known as the Duda Farm in an effort to begin wetland restoration.

In lieu of the February 2005 Council meeting, a tour of the Lake Apopka North Shore Restoration Area was provided by the SJRWMD. Several ongoing projects were reviewed including;

- Extensive remediation of Unit 2 due to increased pesticides in the soils at that site,
- Pumping and alum injection systems to control water levels in 3,000 acres of Unit 2,
- A mesocosom bioaccumulation project to study of safe levels of pesticides in birds and fish,
- A visit to the site for the proposed Apopka-Beauclair Nutrient Reduction Facility,
- Wetland remediation efforts on the former Duda Farms property, and
- A visit to the landing area for the boats involved in the gizzard shad harvesting efforts.

A summary of the site visit is provided in Appendix 11. The summary includes a map of the Lake Apopka North Shore Restoration Area detailing the various project areas of the property.

During the August 2005 Council meeting Dr. Mike Coveney, a Technical Program Manager with the SJRWMD gave a presentation to the Council on projects involving Lake Apopka and Lake Beauclair that included information on the North Shore Restoration Area. A summary outline of the presentation is presented below and the complete presentation is provided in Appendix 12.

- Nutrient reduction strategies for the Upper Ocklawaha River Basin
    - Two vegetative treatment programs have been in operation for years; the Lake Apopka North Shore Restoration Area and the Emeralda Marsh at Lake Griffin
    - Lakes downstream of those projects have shown significant reductions in phosphorus levels due in part to the water treatment within these wetland environments
- Convert farmlands to wetlands
    - Purpose is to reduce phosphorus and restore wetland habitat
    - Lake Apopka Marsh Flow-way was originally designed to be a much larger facility than is currently in operation
    - Pesticide residue levels on the Duda property have been reduced to levels that would allow flooding of the property
    - The permitted use of the organo-chlorine pesticide toxaphene, found on the Duda property, expired in 1990
- Phosphorus loading to Lake Apopka during the period of 1968 – 2002
    - 85% of the phosphorus loading is from current and former agricultural uses of the land
    - Atmospheric deposition accounts for approximately 8% of the phosphorus loading
    - After purchase of the farmlands by the SJRWMD in 1998 the phosphorus levels have steadily decreased
    - All water currently released into Lake Apopka is treated with alum
- Phosphorus loading reductions to Lake Apopka
    - 62.4 million grams/year historically discharged

- 15.9 million grams/year discharged would be needed to meet TMDL for the lake
- A 75% decrease phosphorus in runoff from agricultural lands is required to meet the TMDL

- Project phosphorus loading to accomplish 15.9 million grams/year
  - North Shore Restoration Area 37%
  - Atmospheric deposition 32%
  - Contributions from springs 6%
  - Contributions from tributaries 9%
  - Other sources 16%

- Phosphorus loading to Lake Beauclair (estimated)
  - Dominated by flow from Lake Apopka
  - The TMDL was met in 2000 during the drought because only a limited amount of water was released from Lake Apopka

- Phosphorus loading to Lake Beauclair; Baseline versus Expected
  - With all of the treatment technologies being implemented, it will be difficult to meet the TMDL for Lake Beauclair
  - The Lake Beauclair Nutrient Reduction Facility may prove instrumental for meeting the TMDL for the lake

- Recent water quality data for the Harris Chain of Lakes for the period of June – July 2005
  - Reduced levels of phosphorus since the hurricanes of 2004
  - Increased levels of chlorophyll in Lake Griffin

In addition to the excess phosphorus available for discharge from the property the SJRWMD is also remediating an area within Unit 2 which has been determined to have increased levels of the pesticide Toxiphene. This organo-chlorine pesticide is located at what is believed to be the crash site of a crop dusting aircraft. The Council was presented with information that the SJRWMD has been conducting sampling of not only the soil, groundwater and surface water in the area, but also the testing of fish and wading birds in the area.

During the October 2005 Council meeting Dr. Gian Basili (SJRWMD) explained that the concentrations of Toxiphene appear to have been reduced by natural

processes over time. One explanation he gave was that there are microbial communities in the soil that break-down the organochlorine compounds. In response to a question as to why these compounds are breaking down now as opposed to over the past 50 years he explained that in the past those communities may not have been as robust, due to active farming operations. Additional research on this issue is ongoing.

Benefits of the Lake Apopka North Shore Restoration Area include:

1. The capacity to store large volumes of stormwater runoff and better manage its discharge to Lake Apopka and the downstream lakes;
2. A portion of the property is used as the disposal facility for the dredge material from the Lake Griffin Access Canal Dredging Project, and;
3. Enhanced marshes and wetlands will provide water quality treatment by natural processes and improved wildlife habitat.

The Council will continue to review projects and information provided by the SJRWMD for the North Shore Restoration Area.

2.3.3 Emeralda Marsh Projects

Issue: **More than 40 years of farming operations within the Emeralda Marsh has lead to environmental degradation of Lake Griffin through the discharge of excess nutrients and agricultural chemicals.**

Actions: **The Council will continue to review the evolution of projects by the St. Johns River Water Management District to restore the Emeralda Marsh and the environmental benefits to water quality within the Harris Chain of Lakes.**

The Emeralda Marsh is located between Lake Yale and Lake Griffin. Beginning in the 1950s a system of levees and canals were built to drain this 6,500 acre sawgrass marsh in order to establish farms in the nutrient-rich muck. As with the area north of Lake Apopka, the muck farming activities discharged excess nutrients, primarily phosphorus into Lake Griffin.

In an effort to restore the nutrient filtering marsh the SJRWMD has initiated several projects to improve water quality and wildlife habitat in the Emeralda Marsh. The Council has received updates on the various projects that include:

- Alum treatments to bind phosphorus with the soil as a means to reduce nutrient runoff from the site;
- Improvements to the Lake Griffin Flow-way
- Installation of pumps and culverts to better manage the water stored in the marsh, and;

- Planting of wetland vegetation and cypress trees to improve the filter capability and wildlife habitat within the marsh.

During the March 2005 Council meeting Dave Walker, a Senior Project Manager with the SJRWMD gave a presentation on the Emeralda Marsh and Lake Griffin Flow-way projects. A copy of that presentation is provided in Appendix 13. He explained that the ACoE had approved permits to degrade the levee along the Yale-Griffin Canal. The permits also include the planting of cypress trees in the marsh. Mr. Walker explained that large areas of the marsh had been treated with alum to reduce the availability of phosphorus in discharges and an alum treatment facility will be constructed to treat water released from both the Eustis and Long farms. He said that after treatment, the water from these farms will be released into the Serpentine Swamp and East Pond for additional treatment prior to discharge into Lake Griffin.

Mr. Walker also said that the SJRWMD is currently lowering the water levels at the Laurie Brown site and pumping it into Lake Griffin while they continued to evaluate other water treatment projects that may be built on the site. He said they will initially plant wetland vegetation on the site to enhance water quality treatment and improve wildlife habitat. He also discussed the goals of the SJRWMD for phosphorus discharges from the various areas of the Emeralda Marsh. Mr. Walker explained that the maximum limit of phosphorus permitted to be discharged annually established by the Environmental Protection Agency is 5,000 pounds. Their goal is to discharge a maximum of 1,500 pounds of phosphorus per year.

Mr. Walker said that the marsh and wetland projects discussed will be able to store more water on the sites and to discharge less. This will provide better control of lake levels and also improved flood control for the area, in addition to improved water quality and wildlife habitat.

The Council supports the wetland restoration efforts of the SJRWMD as a method to better manage water levels and water quality in the Harris Chain of Lakes.

2.4 Summary of Council Recommended Actions and Consensus Items

2.4.1 Actions

Following careful review and discussion of information presented and recommendations made by the TAG, the Council voted to make the following recommendations to the SJRWMD and the Florida Legislature.

- The Council continued to support the implementation of the enhanced lake level fluctuation schedules presented by the SJRWMD as a beneficial lake management practice. It is understood that the Lake Griffin Access Canal Dredging project must e completed and other environmental conditions must be met prior to implementation of the fluctuation program.

- The Council supports access canal dredging as a beneficial lake management practice. The Council was awarded $1 million in State appropriations from the Florida Legislature in 2005 to assist in funding the dredging project. Resolution 2005-1 to transfer these funds to the LCWA for the purpose of access canal dredging was approved by the Council in September 2005.

- The Council supports the invasive plant management efforts of the SJRWMD, FWCC, and the Lake County Mosquito and Aquatic Plant Management Section. They were awarded $56,250 in State appropriations from the Florida Legislature in 2005 to assist the Lake County Mosquito and Aquatic Plant Management Section in their management efforts. The Council passed Resolution No. 2005-2 in October 2005 to transfer these funds to the LCWA for disbursement to the proper receiving agency.

- The Council supports the sport fish restocking research and the efforts of the FWCC. The Council was awarded $187,500 in State appropriations from the Florida Legislature in 2005 to assist the FWCC in their Florida largemouth bass restocking efforts. The Council passed Resolution No. 2005-2 in October 2005 to transfer these funds to the LCWA for disbursement to the proper receiving agency.

- The Council supports the revegetation of near-shore aquatic habitats and the planting of cypress trees. The Council was awarded $37,500 in State appropriations from the Florida Legislature in 2005 to assist aquatic habitat revegetation efforts and $18,750 to assist in cypress tree plantings. The Council passed Resolution No. 2005-2 in October 2005 to transfer these funds to the LCWA for disbursement to the proper receiving agencies.

- The Council agreed that there are potential health concerns in the lakes associated with blue-green algae. Furthermore they are moving forward with a program to educate local medical professionals and citizens of the symptoms of toxic algae exposures and the importance of properly reporting exposures.

2.4.2 Consensus Items

Through their review of the technologies and research being conducted on various lake management practices, the Council agreed to support some of the efforts, but noted that further research would be necessary for some of the other technologies, and would not support others.

- The Council offered their continued support of the experimental investigation efforts of rough fish harvesting (predominately gizzard shad) as a method of water quality improvement.

- The Council agreed to continue to review analytical data provided by the SJRWMD for the Lake Apopka Marsh Flow-way in an effort to evaluate marsh flow-way systems as a potential lake management practice.

- The Council agreed to continue to review information provided by the SJRWMD for the Lake Beauclair Nutrient Reduction Facility as a means to reduce phosphorus concentrations in water released to downstream lakes.

- The Council agreed to continue to review information provided by the SJRWMD for projects in the Lake Apopka North Shore Restoration Area to improve the quality of water discharged to Lake Apopka and wetland habitat.

- The Council agreed to continue to review analytical data provided by the SJRWMD for improvements to the Apopka-Beauclair Canal and the restoration of Lake Beauclair.

- The Council offered their continued support of the efforts by the City of Leesburg Department Environmental Services in the improvement of their sanitary sewer and wastewater treatment systems. During the September 2005 Council meeting it was agreed that the upgrades to the City of Leesburg wastewater systems had progressed to the point where they may no longer need to be updated with the Council.

- The Council agreed to continue to monitor and support the FDEP TMDL/PLRG program.

2.5 Requested Funding

The Harris Chain of Lakes Restoration Council received a combined total of $50,000 in funding for administrative and operational costs from the LCWA ($10,000) and the SJRWMD ($40,000) during the 2004 – 2005 fiscal year. A portion of these funds are available for reimbursement of guest speakers who make presentations to the Council.

The Council will prepare and submit individual and combined funding initiatives to the Florida Legislature to support lake management and restoration projects as outlined below.

Funding:

Individual Funding Request

- The Council passed a motion to support the appropriation of $2,000,000 in State funds to assist the LCWA in the completion of the Lake Griffin Access Canal Dredging Project.

Combined Funding Initiative Request

- The Council passed a motion to support the appropriation of $300,000 in State funds for the purpose of Florida largemouth bass restocking to improve the economic vitality of the Harris Chain of Lakes.

- The Council passed a motion to support the appropriation of $300,000 in State funds for the purpose of wetland and aquatic habitat restoration.

- The Council passed a motion to support the appropriation of $150,000 in State funds to the Lake County Mosquito and Aquatic Plant Management Section to assist in funding their efforts to control invasive species of aquatic plants.

- The Council passed a motion to support of the appropriation of $250,000 in State funds to support cyanobacteria monitoring in cooperation with the Florida Department of Health in the Harris Chain of Lakes.

The Council requested no other funding during the period of this report.

3.0 Appendices

Appendix 1	Enacting Legislation
Appendix 2	Overview of the Harris Chain of Lakes
Appendix 3	Excerpts from Monthly Meetings
Appendix 4	Resolution No. 2005-1; A RESOLUTION OF THE HARRIS CHAIN OF LAKES RESTORATION COUNCIL REQUESTING THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT TO TRANSFER $1,000,000 IN 2005 STATE APPROPRIATIONS TO THE LAKE COUNTY WATER AUTHORITY FOR THE PURPOSE OF CANAL ACCESS DREDGING EFFORTS ON LAKE GRIFFIN
Appendix 5	Presentation by Dr. Mike Allen of the UF Fisheries and Aquatic Sciences Department on hydrilla management
Appendix 6	Resolution No. 2005-2; A RESOLUTION OF THE HARRIS CHAIN OF LAKES RESTORATION COUNCIL REQUESTING THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT TO TRANSFER $300,000 IN 2005 STATE APPROPRIATIONS TO THE LAKE COUNTY WATER AUTHORITY FOR THE PURPOSE OF SUPPORTING REVEGETATION WITH NATIVE VEGETATION, STOCKING OF LARGEMOUTH BASS, CONTROLING EXOTIC AND INVASIVE VEGETATION, AND PLANTING CYPRESS TREES
Appendix 7	Presentation by Dr. JoAnn Burkholder, Associate Professor of Aquatic Botany and Marine Sciences at North Carolina State University
Appendix 8	Presentation by Dr. Mike Allen of the UF Fisheries and Aquatic Sciences Department on gizzard shad
Appendix 9	Presentation of phosphorus data collected from the SJRWMD on Lake Beauclair by Councilman Charles Clark
Appendix 10	Presentation by Lance Lombard of the LCWA on the Lake Beauclair Nutrient Reduction Facility
Appendix 11	February 2005 Council site visit to the Lake Apopka North Shore Restoration Area
Appendix 12	Presentation by Dr. Mike Coveney of the SJRWMD on projects involving Lake Apopka, Lake Beauclair and the North Shore Restoration Area
Appendix 13	Presentation by Dave Walker of the SJRWMD on the Emeralda Marsh and Lake Griffin Flow-way projects
Appendix 14	Relevant Literature and Acknowledgements

All appendices are included on the CD that accompanies this report.

4.0 Acronyms and Abbreviations

ACoE	United States Army Corps of Engineers
A-B Canal	Apopka-Beauclair Canal
B.A.S.S.	Bass Anglers Sportsman Society
BMAP	Basin Management Action Plan
BMPs	Best Management Practices
CDC	Centers for Disease Control
cfs	cubic feet per second
CR	County Road
DNA	Deoxyribonucleic acid
DO	Dissolved oxygen
EPA	United States Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FWCC	Florida Fish and Wildlife Conservation Commission
FWS	United States Fish and Wildlife Service
IFAS	Institute of Food and Agricultural Sciences
kg/yr	kilograms per year
LCWA	Lake County Water Authority
N:P Ratio	Nitrogen to Phosphorus Ratio
NGVD	National Geodetic Vertical Datum
PLRG	Pollutant Load Reduction Goal
ppb	parts per billion
SJRWMD	St. Johns River Water Management District
TAG	Technical Advisory Group
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
UF	University of Florida

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P.O. Box 46398, Tampa, Florida 33647
(813) 903-2329 ♦ info@appliedsciencesci.com ♦ Fax (813) 434-2454